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(54) Holograms.

(57) There is described an article which comprises on its outside a light-transparent visual display feature through which a graphic design or a solid object can be seen, the light-transparent visual display feature comprising a light-transparent film sheet which contains a Lippman-Bragg reflection hologram which has a viewing angle of not more than 20° either side of a selected viewing axis or axes and a depth of holographic image which is not more than 5mm on one side or the other of the image plane.

When the article of the present invention is a package, the restricted view is advantageously prepared to be around a vertical axis relative to the observer so that as an observer passes the illuminated package laterally with the hologram on the vertical face, the hologram will suddenly come into view and just as suddenly slip from view as viewing angle is passed.

When the article of the present invention is an ID card, the transparent film material bearing the hologram is laminated on to the top surface of the card which bears a graphic design relevant to the holder of the card. The holographic image may be the name of the firm or organisation. This acts as an additional security overlay. The graphic design is visible the whole time when the ID card is inspected but the holographic image appears and then disappears as the viewing angle of the card changes as it is being inspected. Instead of the name of the firm, additional security can be incorporated if the holographic image complements or completes the graphic design on the ID card. When used in this way, the holographic security image can be as large as the physical dimensions of the card without detracting from the spac allocated to the conv ntionally printed graphics present on the card.

EP 0 403 134 A2

HOLOGRAMS

This invention relates to the use of holograms for display purposes.

For example, in recent years a lot of money has been spent in the packaging of articles to make the packaged goods look more appealing on shelves. Apart from using coloured papers and ribbons and novel shaped containers this appeal has been enhanced by the graphics used on the packaging. To complement the graphics use has been made of embossed holograms. However, the colour of embossed holograms is strongly dependent on the angle between the observer and the hologram or between the hologram and the illuminating light source and often the effect is neither pleasing nor eye catching. Further embossed holograms are required to be provided with a silver mirror backing and this often detracts from the overall packaging concept and they are difficult to observe in poor lighting conditions. We have found a method of using holograms to enhance the eye-appeal of packages which do not suffer from the above disadvantages.

Further it has been proposed to incorporate a hologram as a security feature in an identification card (I.D. card). This has usually taken the form of a small embossed hologram in one corner of the card. This is not very striking.

Therefore according to the present invention there is provided an article which comprises on its outside a light-transparent visual display feature through which a graphic design or a solid object can be seen, the light-transparent visual display feature comprising a light-transparent film sheet which contains a Lippman-Bragg reflection hologram which has a viewing angle of not more than 20° either side of a selected viewing axis or axes and a depth of holographic image which is not more than 5 mm on one side or the other of the image plane.

Preferably the viewing angle is not more than 20° about any two non-parallel axes in the plane of the hologram. In the ase of a hologram displayed on a vertical plane, this means that the image can only be viewed from a range of positions restricted in the horizontal and/or vertical planes. Outside this range the hologram appears to carry no image.

However this means that the hologram appears very bright even when viewed by non-specific lighting. The small depth of the holographic image means that the hologram appears to be very sharp.

By Lippman-Bragg reflection hologram is meant a hologram in which the interference fringes are substantially perpendicular to the light rays used to reconstruct the image and this usually means that the fringes are parallel to the plane of the base on which the photosensitive layer is coated. Such holograms are also known as volume holograms as the fringes which provide on reconstruction the holographic image are in the depth of the photosensitive layer rather than on the surface as is the case with embossed holograms.

A particularly useful Lippman-Bragg hologram for use in the present invention can be prepared from silver halide photosensitive materials the size of the silver halide crystals used being from about 0.02 to 0.05 μm average mean size. Bright holographic images can be obtained using lasers to expose the material and processing the material using a silver halide developing solution followed by a rehalogenating bleach. That is to say a bleach bath which bleaches out the exposed silver formed during the silver halide development and redeposits this dissolved silver within the material. The use of a He:Ne laser which has a peak emission wavelength of 633 nm results in a hologram which replays at about 600 nm exhibiting a reddish-gold colour which is particularly effective for display purposes.

Other photosensitive layers from which Lippmann-Bragg holograms may be prepared include dichromated gelatin and photopolymers.

US patent specification No. 4173474 describes a method for forming a hologram using a photopolymerisation mixture. Another such system is described in WO 85/01127 but the branched polyethylenemine serves both as the polymerisation initiator and as the hydrophilic water-swellable binder.

The required narrow viewing angle may be obtained by increasing the distance of the transmission master when the reflection master is being prepared. Or by using a small transmission master at the usual distance from the reflection master. In either case the narrow viewing angle is a result of the narrow solid angle subtended by the transmission master at the reflection master during its preparation. Reflection holograms prepared in this way will only be visible though the solid angle defined by the position of the transmission master. For very small viewing angles the image may fall only on one of the observers eyes at a given viewing distance. This may be disconcerting for the observer and it is preferable that the reflection master is designed to r play the same image into both of the observers eyes at the expected vi wing distance. In practice this may set a limit on th smallest angle of view around a vertical axis which is generally acceptable. A narrow angle of view around a horizontal axis relative to the observer is likely to be more generally acceptable. The required small depth of the holographic image may be obtained by selection of a suitable image and preparation of a suitable transmission master therefrom. Preferably the

depth of the holographic image is less than 2 mm from one side or the other of the image plane. Thus what is achieved is in essence a bright two dimensional hologram which switches on and off rather than a three dimensional holographic imag which appears to be suspended in spac in front of the holographic material which comprises the interference fringes.

Holograms of this type can be reconstructed, that is to say, made visible, using diffuse lighting and in particular fluorescent lighting as is usually present in stores in which packaged articles are on display.

When the article of the present invention is a package the restricted view is advantageously prepared to be around a vertical axis relative to the observer so that as an observer passes the illuminated package laterally with the hologram on the vertical face the hologram will suddenly come into view and just as suddenly slip from view as viewing angle is passed.

If the restricted view is about a horizontal axis it means that as an observer raises or lowers his eyes the hologram will suddenly come into view and then disappear again. If the restricted view is around both horizontal and vertical axes then there is effectively only one viewing position. Thus from the point of view of enhancing display of goods on a shelf preferably the viewing angle is restricted to not more than 20° either side of a selected axis or axes. Thus viewing angle can be as small as 5° but then the hologram is only visible for a very short time as the observer passes the package. If a plurality of packages-articles comprising one hologram on each on the vertical face of the package are placed in line as an observer passes the line first one hologram and then the next one will switch on and then off providing a very eye catching display. These holograms can all be the same or different so providing a sequential message.

Alternatively each package-article may comprise, for example, two holograms which switch on at different angles of view. These holograms can be on different areas of the package-article or on the same area and can be illuminated by alternating spot lamps.

The package-articles of the present invention are preferably boxes made from cardboard, stiffened paper or sheet plastics material or other self-supporting material which can be fabricated into a box.

A particular package-article of the present invention comprises a covering for the articles having a transparent window in the covering through which the articles contained therein can be seen, the transparent window comprising a Lippman-Bragg reflection hologram which has a viewing angle of not more than 20° either side of the normal and a depth of holographic image which is not more than 5 mm on one side or the other of the image plane.

Preferably the package-article is a cardboard box with a portion cut out of one side through which the contents of the package are visible. A transparent holographic material which comprises a hologram as just defined covers this cut-out portion. If the hologram is present on sufficiently thick film base, that is to say, at least 60 µm then the holographic material itself may be used to cover the cut-out portion. If, however, the hologram to be used is present on thinner film base then a transparent film sheet which is at least 60 µm thick should be used to cover the opening and the holographic material which comprises the hologram should be laminated to this sheet.

When such a box is displayed with the light at a suitable angle the contents of the box are visible through the cut-out portion and as an observer passes the box, the hologram on the cut-out portion will switch on and off depending on the position of the observer.

Another package-article of the present invention is preferably a box of least one side of which comprises adhered to the box a reflection hologram as hereinbefore defined.

This side or even the whole box can comprise no printed matter and be of a single colour, for example, black or white. The hologram can then comprise all the required information such as the name of the product and its manufacturer. Thus initially the box appears to have no information on it but as an observer passes it suddenly the requisite information will appear and then disappear.

Alternatively, the sides of the box may comprise the usual information about the product and over one side of the box, a hologram as thereinbefore defined may be laminated to the box or to a film sheet which covers the box. Thus under normal lighting conditions present in a store, the information about the contents of the box will be visible but as an observer passes by, additional information will switch on and then disappear.

A particularly pleasing effect is obtained if the information contained on the hologram is exactly the same as some of the information on the side of the box, for example, the manufacturer's name and name of the product. The hologram should then be affixed to the box so that the information in th hologram is xactly in r gister with the similar information on th box. Then und r the normal lighting conditions in most viewing positions, the observer will see on the box the usual information then as he he pass s the box, the most important information will suddenly be reinforced and then diminished.

The article of the present invention may be a card or other flat surface on which there is present a graphic design. Over this design there is present the light-transparent film sheet bearing th hologram. Th

graphic design is visible th whole time through the film sheet but th hologram is only visible at certain viewing angles. The hologram may relate to the graphic design or it may convey a message not related to the graphic design. For xample, th graphic design may be a card bearing no letters but only a picture of a dog. The hologram in this case can be of the letter 'D' through which the pictur of the dog is visibl . Mostly the letter 'D' will not be visible but as a child alters the viewing position of the card the letter 'D' will appear and then disappear, thus emphasising the relationship between the dog and the letter 'D'.

When the article of the present invention is an I.D. card, the transparent film material bearing the hologram is laminated on to the top surface of the card which bears a graphic design relevant to the holder of the card. The holographic image may be the name of the firm or organisation. This acts as an additional security overlay. The graphic design is visible the whole time when the I.D. card is inspected but the holographic image appears and then disappears as the viewing angle of the card changes as it is being inspected. Instead of the name of the firm, additional security can be incorporated if the holographic image complements or completes the graphic design on the I.D. card. When used in this way, the holographic security image can be as large as the physical dimensions of the card without detracting from the space allocated to the conventionally printed graphics present on the card.

In the holographic material used in the present invention the supporting base may be any transparent base used in the photographic industry, for example biaxially oriented polyethylene terephthalate or polycarbonate or a cellulose derivative such as cellulose triacetate.

The photosensitive layer may have been coated on the base by any of the conventional techniques well known to the photographic industry such as by use of a doctor bar, or by slot, cascade curtain or dip methods. The coated layer may then be dried by normal hot air methods. When the material is a dichromated gelatin hologram (D.C.G. hologram) the coated gelatin layer is sensitised with a dichromate solution just before it is holographically exposed.

In order to produce the required hologram exhibiting both brightness and sharpness and having a restricted viewing angle of not more than 20° either side of the normal and a depth of holographic image which is not more than 5 mm on one side or other of the image plane, a lengthy process requiring the production of intermediate masters is usually required. For example, if a company's logo is required to be present on the hologram, a bas-relief model of the logo having a black background is prepared. This is used as the object to prepare a master transmission hologram using silver halide holographic material coated on film base and a He:Ne laser. After processing this transmission is used to prepare a reflection master. During this exposure using also a He:Ne laser the distance between the transmission master and the holographic material may be selected to achieve the desired narrow viewing angle.

The holographic material is then processed to achieve a replay wavelength of 633 nm and the highest possible reflectivity. When a hologram is exposed to a laser of a certain emission peak wavelength usually it will replay at a lower wavelength but in European patent applications 225852 and 230208, methods of increasing the replay wavelength of processed holograms are described. The reflection hologram of the required replay wavelength may then be laminated between two sheets of glass to prevent atmospheric moisture from swelling the gelatin binder and thus altering the replay wavelength. This is then the reflection master. A large number of copy reflection hologram can then be prepared from this reflection master by well known contact printing methods.

Example of a Hologram for use in the present invention

Samples of holographic material were prepared by coating onto a transparent photographic film base a gelatino silver halide emulsion which was substantially pure silver bromide having a mean crystal size of 0.03 μm at a silver coating weight of 30 mg/dm^2. The emulsion was optically sensitised with a red sensitising dye so that it was optimally sensitive to 633 nm the colour of a He:Ne laser.

A model of a company logo

was then prepared and a transmission master hologram was prepared therefrom using a sample of the holographic materials as just described. The exposed material was then developed for 2 minutes in a solution of the following formulation :-

Sodium Sulphite Anhydrous	30 g
Hydroquinone	10 g
Sodium Carbonate	60 g
Water to	1000 ml

The developed sample was then transferred to a rehalogenating bleach bath of the following composition :-

Fe (NH_4) EDTA (1.8m Solution)	150 mls
KBR	10 g
pH	5.5
Water to	1000 mls

until all the silver metal had been bleached out which was about 2 minutes.

After washing and drying the transmission master thus prepared was used to prepare the reflection master in the manner as described above using a He:Ne laser. The relative positions of the transmission master and the sample of holographic material were adjusted to ensure that the exposed and processed hologram had a narrow viewing angle of 6° on either side of the normal. The depth of image was less than 2 mm in front of the image plane. Processing was as set forth above but the method described in EP 225852 was employed after the rehalogenating bleach bath to restore the peak replay wavelength to 633 nm. This hologram was laminated between two glass plates to constitute the reflection master. This reflection master was then used to prepare a large number of copy holograms using a contact copying process and exposing with a He:Ne laser. The development and rehalogenating bleach bath were as set forth above. The replay wavelength of these copy holograms was found to be 600 nm which is a rich gold colour. Thus the logo

was present on the transparent film base as a rich gold colour. The hologram had a viewing angle of 6° and depth of image 2 mm in front of the image plane.

The accompanying drawings will serve to illustrate the invention.

Figure 1 is a perspective view of a box containing articles with a cut-out portion.

Figure 2 is the same perspective view of the base of figure 1 with the cut-out portion covered with a sample of the hologram as just prepared.

Figure 3 is a top view of an I.D. card having a graphic design thereon.

Figure 4 is the same top view of the I.D. with a light-transparent film material bearing a hologram laminated thereto.

In figure 1 a cardboard box 1 has a cut-out portion 2 in one face thereof 3. Though this cut-out portion can be seen the neck of a bottle 4 which is contained in the box 1. The manufacturer's company logo 5 is printed on the face 3 of the box.

In figure 2 wherein the same numbers have the same signification a transparent film 6 comprising a hologram 7 has been adhered over the cut-out portion 2. This is shown at a viewing angle at which it is visible. A brilliant image of the logo Jones is shown over the neck of the bottle 4. However, as the angle of view is changed this logo would disappear.

In figure 2 the transparent film 6 has been shown covering the outside of the cut-out portion 2 in practice it would be adhered to cover the portion 2 on the inside of the base 1.

In figure 3 an I.D. card 10 which is composed of laminated plastic sheets has a white top surface 12 which carries a graphic design 13. (In practice the clear holographic overlay would be bonded to the card with a tamper-proof security adhesive).

In figure 4 wherein the same numbers have the same signification a transparent film 14 comprising the hologram 15 has be n affixed to cover the whole top surface 12.

Claims

1. An articl which comprises on its outside a light-transparent visual display feature through which a graphic design or a solid object can be seen, the article being characterised in that the light-transparent visual display feature comprises a light-transparent film sheet which contains a Lippman-Bragg reflection hologram which has a viewing angle of not more than 20° either side a selected viewing axis or axes and a depth of holographic image which is not more than 5 mm on one side or the other of the image plane.

2. An article according to claim 1 which is a package composed of a covering having a transparent window in the covering through which the objects contained therein can be seen, the article being characterised in that the transparent window comprising a Lippman-Bragg reflection hologram which has a viewing angle of not more than 20° either side of the normal and a depth of holographic image which is not more than 5 mm on one side or the other of the image plane.

3. An article according to claim 2 characterised in that the article is a cardboard box with a portion cut-out in one side.

4. An article according to claim 1 characterised in that the article is a box at least one side of which comprises a reflection hologram as defined in claim 1.

5. An article according to claim 4 characterised in that the information on the hologram is exactly the same as some of the information on the box and the hologram is affixed on the box so that the information on the hologram is in register with the same information on the box.

6. An article according to claim 1 characterised in that the article is a card on which is present a graphic design, the said graphic design being covered by the light-transparent film sheet bearing a hologram.

7. An article according to claim 1 characterised in that the Lippman-Bragg hologram is silver halide sensitised material, dichromated gelatin or a photopolymerisation mixture.

8. An article according to claim 7 characterised in that the silver halide sensitised material contains silver halide crystals having an average size of from 0.02 to 0.05 μm.

9. An article according to claim 8 characterised in that the hologram has been prepared using a He:Ne laser and processed in a silver halide development bath followed by a rehalogenating bleach bath.

FIG.1

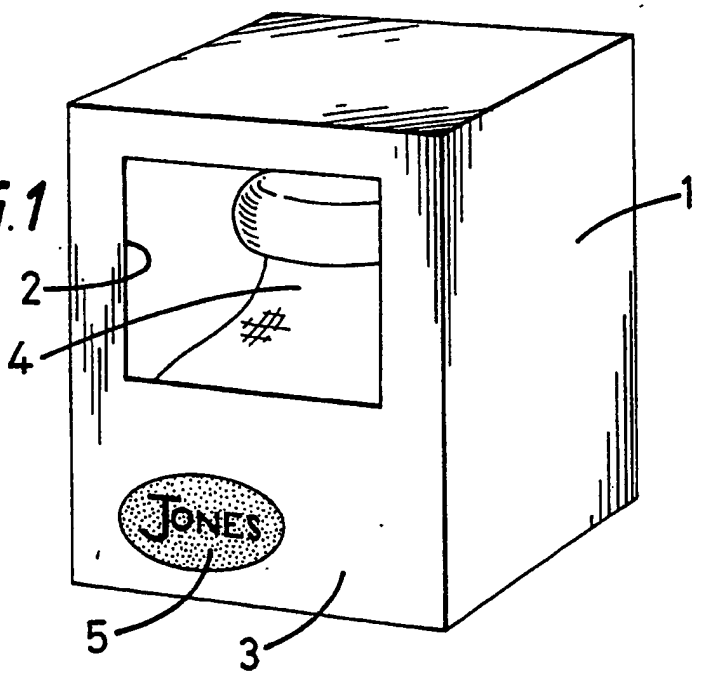

FIG.2

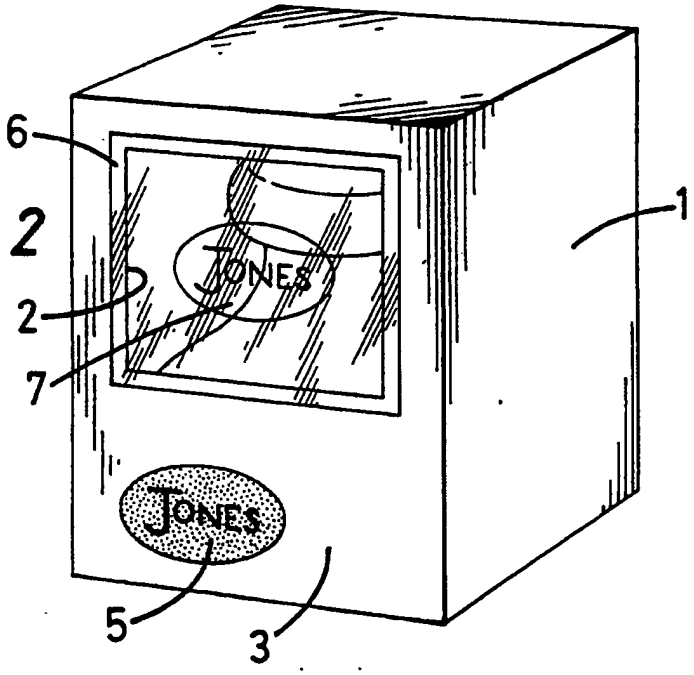

FIG.3

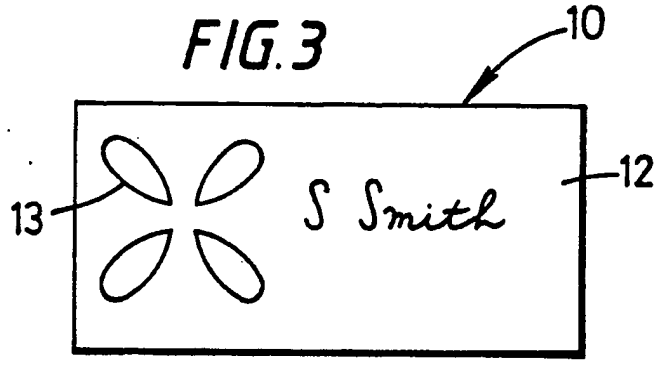

FIG.4